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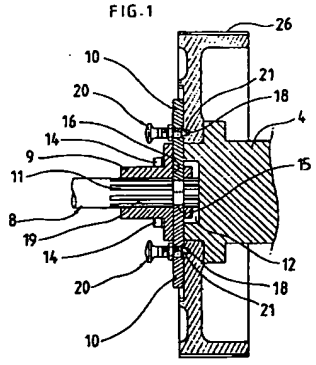
(54) **SCREW CONNECTING STRUCTURE OF INJECTION MOLDING MACHINE.**

(57) A screw connecting structure of an injection molding machine in which a spline bush (9) in which a spline part (11) formed on the base end of a screw (8) is fitted is fixed to the front surface of a screw sleeve (4), and the retainer (10) prevents the screw (8) from coming off the spline bush (9). The spline bush (9) fits into the spline part (11) formed on the base end of the screw. An annular groove (15) is formed in the spline part (11) at the base end of the screw. The spline bush (9) is provided at the part thereof corresponding to the annular groove (15) at the base end of the screw fitted therein with a through-hole (16) as a retainer fitting hole (16). The retainer (10) is inserted into the retainer fitting hole (16) in the spline bush so that the front end of the retainer reaches the annular groove (15) at the base end of the screw, whereby the screw (8) does not come off the screw sleeve (4).

FIG.1



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TECHNICAL FIELD

The present invention relates to a structure for linking a screw in an injection molding machine with a sleeve transmitting an axial injection force and a rotational force for measurement to the screw.

BACKGROUND ART

An injection molding cycle in an injection molding machine comprises a clamping process for clamping a mold; an injection process for injecting a molding material (or a molten resin) into a cavity of thus clamped mold; a dwell process for keeping the material filled into the mold cavity at a predetermined pressure for a given period of time after injection; an opening process for opening the mold to remove the molded product; and measurement and melting process for measuring and melting the introduced molding material by the application of heat and and screw rotation.

In the injection process, the screw is driven toward a nozzle without rotation. In the measurement process, the screw is forced to retreat from the dwell position with rotation.

Thus, the screw of the injection molding machine necessitates a transmission of both axial and rotational forces. To this end, a conventional injection molding machine of in-line screw type (in which the melting and injection of the molding material are effected in a coaxial manner) includes a screw linkage structure as shown in Fig. 4.

The in-line screw injection molding machine depicted in Fig. 4 comprises a pusher plate 1 receiving a tie bar 2 of the injection section and slidably displaceable to-and-fro. The pusher plate 1 includes at its center a housing 3 secured thereto, and at its front a screw sleeve 4 (hereinafter referred to simply as a sleeve 4) supported by a bearing 5 so as to be rotatable with respect to the housing 3. On the rear side of the pusher plate 1 there is arranged an injection mechanism 6 whose fore-end is supported on the plate 1. The sleeve 4 is provided with a pulley 7 which is rotationally driven by a servo-motor for measurement (not shown). A screw 8 is loaded onto the front surface of the sleeve 4 with the aid of a linkage structure comprising a spline bush 9 and a retainer 10 so that the movement in the axial direction (or to-and-fro direction) arising from the injection mechanism 6 and the rotational movement caused by the measuring servo-motor can be transmitted to the screw 8.

Fig. 5 depicts in more detail a structure for linking the screw 8 to the sleeve 4, which corresponds to the structure disclosed in Japanese Patent Laid-open Publication No. 1-115615, in which a splined portion 11 formed on the rear end of the screw 8 is fitted into a spline bush 9, and then the spline bush 9 is fitted into an insertion hole 12 provided in the front surface of the sleeve 4. The portion of the screw 8 immediately in front of the splined portion 11 is fashioned into a small diameter portion 13 to define at the fore-end of the splined portion 11 a shoulder which is brought into contact with the rear surface of the retainer 10. The spline bush 9 and the retainer 10 are then externally fastened to the sleeve 4 by means of common bolts 14 so that the base of the screw 8 can be driven in both axial and rotational directions by the sleeve 4.

Inconveniently, this structure involves a drawback that the small diameter portion 13 which must be arranged immediately in front of the splined portion 11 for the attachment of the retainer 10 to the screw 8 presents a less strength against the torsion or bending moment to be applied thereto when the screw 8 is rotated by the sleeve 4. Furthermore, the shoulder at the fore-end of the splined portion 11 substantially serves as a fore-end surface of spline teeth which is allowed to abut against the rear surface of the retainer 10. Due to its smaller contact area, however, there may sometimes arise a plastic deformation in the spline teeth or the retainer 10. In addition, the retainer 10 requires a larger diameter enough to cover the spline bush 9 for the attachment to the sleeve 4.

In another conventional structure for linking the screw 8 with the sleeve 4, as is apparent from the prior art as shown in Fig. 6, the splined portion 11 formed on the base (or the rear end) of the screw 8 is provided with an annular groove 15 to which the retainer 10 halves are mounted from both sides with respect to the axial direction. The splined portion 11 is then fitted into the spline bush 9 which is in turn firmly fixed to the sleeve 4 by means of the bolts 14, thereby establishing a linkage of the screw 8 with the sleeve 4.

The structure depicted in Fig. 6 presents such advantages that the small diameter portion created by the annular groove 15 is not subjected to torsion or bending moment and thus is free from the impairment in strength of the screw 8, which may overcome the above drawbacks, and that the retainer 10 is small in size and is not permitted to come off upon loading into the sleeve 4 irrespective of counterparts since the retainer 10 is first of all firmly attached to the spline bush 9. In this structure, however, the spline bush 9 presses against the retainer 10, and accordingly the spline bush 9 must be removed after unscrewing the bolts 14 in order to unload the screw 8, which may result in a laborious work in a narrow operating space.

Nevertheless, the screw 8 of the injection molding machine must be unloaded or changed at

the time of resin replacement or inner cleaning, or may be possibly replaced with new one as an expendable supplies. In the case of molding using a resin where hard particles such as a glass fiber are mixed in particular, the screw may undergo an extreme wear and need a further replacement after a lapse of short period of time. It is thus desirable for the linkage structure between the screw 8 and the sleeve 4 not only to have a sufficient strength but also to be easy to load and unload the screw.

DISCLOSURE OF THE INVENTION

It is therefore the object of the present invention to provide a screw linkage structure in an injection molding machine, capable of simply loading and unloading the screw without using any tool and free from impairment in strength of the screw base.

In order to accomplish the above object, the screw linkage structure in an injection molding machine according to the present invention comprises a screw having at its base a spline portion; a spline bush receiving the spline portion of the screw; a screw sleeve having a front surface to which the spline bush is fixed; a retainer serving to prevent the screw from being disengaged from the spline bush; the spline portion formed on the screw base including an annular groove, the spline bush including a through-hole at the position corresponding to the annular groove of the screw base to be fitted thereinto, the retainer being inserted into the through-hole of the spline bush until its leading edge reaches the annular groove of the screw base; and a fastener means for fastening the retainer whose leading edge is engaged with the annular groove to the side of the screw sleeve.

Preferably, the through-hole provided in the spline bush comprises a couple of through-holes each confronting the other with respect to the axis of the screw, and correspondingly the retainer also comprises a couple of retainers.

Preferably, the retainer is fashioned into an elongated plate and has at its one edge a notch configured to correspond to the annular groove of the screw base.

More preferably, the fastener means to be attached to the retainer comprises a plunger, a pin, and a spring for biasing the pin toward the direction in which the pin protrudes from the plunger, while the screw sleeve includes at its front surface an engagement hole for receiving the pin at the position corresponding to that of the pin under the condition that the leading edge of the retainer has reached the annular groove of the screw base.

According to the present invention as described above, the provision of the retainer attachment hole radially extending through from the outer surface of the sleeve including the spline bush up to the splined hole of the spline bush enables the retainer to be attached to and detached from the screw base without removing the spline bush, thereby ensuring a simple loading and unloading of the screw without using any tool. The annular groove and its vicinity are not subjected to a torsion or bending force which may impair the strength of the screw.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a partially sectional view showing an embodiment of the present invention;

Fig. 2 is an exploded perspective view also showing the embodiment of the present invention;

Fig. 3 is a partially enlarged view of the partially sectional view in Fig. 1;

Fig. 4 is a partially sectional view showing a conventional example;

Fig. 5 is a partially enlarged view of the partially sectional view in Fig. 4; and

Fig. 6 is a partially enlarged view showing another conventional example in place of the partially enlarged view in Fig. 5.

BEST MODE FOR CARRYING OUT THE INVENTION

Figs. 1 and 2 depict, in partially sectional view and perspective view, respectively, a screw linkage structure of the present invention by way of example, serving to link a screw 8 with a screw sleeve (hereinafter referred to simply as a sleeve) 4 which drives the screw 8 in both axial and rotational directions and having a spline bush 9 and a pair of retainers 10 described in detail later.

The screw 8 has a base to be linked with the sleeve 4 and provided with a spline. The splined portion 11 is formed with an annular groove 15.

On the contrary, the sleeve 4 is provided with a pulley 26 and has at its front surface an insertion hole 12 for receiving a part of the spline bush 9 and the base of the screw 8.

The spline bush 9 has at its center a spline to be mated with the splined portion 11 of the screw 8. The spline bush 9 further includes a radially extending through-hole for receiving the pair of retainers 10 described later, that is, a retainer attachment hole 16.

As shown in Fig. 2, the retainer 10 is comprised of an elongated plate whose one end is semi-circularly notched to fit the outer periphery of the annular groove 15 of the screw 8.

The spline bush 9 is fixedly secured to the front surface of the sleeve 4 by means of six bolts 27. Under the condition where the spline bush 9 is

fastened to the sleeve 4, as shown in Fig. 1, the splined portion 11 of the screw 8 is engaged with the spline bush 9 to prohibit their relative rotations. As is apparent from Fig. 1, the extremity of the screw 8 fitted into the spline bush 9 is further introduced into the insertion hole 12 provided in the front surface of the sleeve 4 in such a manner that the annular groove 15 of the screw 8 confronts the retainer attachment hole 16 of the spline bush 9. Under such condition, therefore, the notched edge of the retainer 10 is allowed to freely reach the annular groove 15 of the screw 8 through the retainer attachment hole 16, as shown in Fig. 1.

A couple of plungers 20 illustrated schematically and in enlarged view in Figs. 2 and 3, respectively, serve as means for restraining the radial movement of the retainer 10 through the retainer attachment hole 16 in the spline bush 9 to hold the condition where the edge of the retainer 10 are fitted into the annular groove 15 of the screw 8. The couple of plungers 20 are attached to the retainer 10 at the points not blocked by the spline bush 9 by means of screwing, for example.

As shown in Fig. 3, the plunger 20 comprises a tubular body 23 having on its outer periphery a threaded portion 22, a pin 21 with a finger grip 24 fitted into the body 23, and a spring 25 housed in the body 23 to always bias the pin 21 toward the direction in which the tip of the pin 21 projects. The threaded portion 22 on the outer periphery of thus structured plunger 20 is adapted to engage with a couple of threaded holes provided on the retainer 10. The pin 21 can be retracted within the interior of the body 23 by pulling the plunger 20 by the finger grip 24 against the biasing force of the spring 25. On the contrary, a couple of holes for receiving the pin 21 of the plunger 20, namely, pin engagement holes 18 are provided on the side of the sleeve 4. In this embodiment, the couple of pin engagement holes 18 are formed in the pulley 26 secured to the sleeve 4.

When the finger grip 24 of the plunger 20 is released under the condition where the semi-circularly notched edge of the retainer 10 is fitted into the annular groove 15 of the screw 8 through the retainer attachment hole 16, the pin 21 of the plunger 20 is permitted to project from the plunger body 23 by the resilience of the spring 25 to be engaged with the pin engagement holes 18 on the sleeve side (pulley 26). Under such condition, the retainer 10 is restrained from displacing in the radial direction of the spline bush 9 so as to maintain the state of the retainer 10 whose notched edge is being fitted into the annular groove 15 of the screw 8. As a result, the screw 8 is prevented from being disengaged from the spline bush 9 by virtue of the retainer 10.

The structure for the linkage of the screw 8 with the sleeve 4 as described above ensures a secure transmission of not only a rotational movement of the pulley 26 to the screw 8 by way of the spline bush 9, but also an axial movement of the sleeve 4 to the screw 8.

In order to remove the screw 8 from the sleeve 4 side, the retainer 10 may be moved radially outwardly with respect to the axis of the screw 8 (or in the direction away from the axis) while pulling the plunger 20 by the finger grip 24. In other words, provided that the pin 21 is disengaged from the pin engagement hole 18 by pulling the finger grip 24 against the resilience of the spring 25, then the retainer 10 can be freely displaced in the radial direction of the axis of the screw 8. Hence, the retainer 10 is outwardly displaced until the notched edges thereof are disengaged from the annular groove 15.

After the screw 8 has been removed from the sleeve 4 side in this manner, another screw 8 may be linked with the sleeve 4 side for replacement. In this case, the splined portion 11 of the screw 8 is fitted into the spline bush 9 in such a manner that the annular groove 15 of the screw 8 confronts the retainer attachment hole 16 of the spline bush 9, and then the retainer 10 is inwardly moved in the radial direction with respect to the axis of the screw 8 (that is, in the direction coming closer to the axis) until the notched edges thereof are brought into engagement with the annular groove 15 of the screw 8. The finger grip 24 of the plunger 20 is then released to allow the pin 21 to engage with the pin engagement hole 18.

It is to be appreciated that the positional relationship between the annular groove 15 of the screw 8 and the retainer attachment hole 16 of the spline bush 9 is such that the annular groove 15 of the screw 8 just coincides with the retainer attachment hole 16 of the spline bush 9 when the screw 8 is inserted into the spline bush 9 until its end surface is abutted against the bottom of the insertion hole 12 of the sleeve 4, as shown in Figs. 1 and 2.

In either case of attachment or detachment of the screw 8 as discussed hereinabove, there is no need for the removal of the spline bush 9 serving to hold the retainer 10, thus enabling the screw 8 to be easily attached or detached without any difficult work such as, for example, use of tools at the point around which the mechanism is complicated.

The above is merely an embodiment of the present invention, and hence the plunger 20 may be replaced by other anti-disengagement means such as a hook easy to attach and detach. Further, in this embodiment, the pair of retainers 10 are introduced into the retainer attachment hole 16 from both sides toward the axis of the screw 8, but

alternatively, a single integral retainer 10 may be inserted thereinto from only one side.

Claims

1. A screw linkage structure in an injection molding machine, comprising:
   a screw having at its base a spline portion;
   a spline bush receiving said spline portion of said screw;
   a screw sleeve having a front surface to which said spline bush is fixed; and
   a retainer serving to prevent said screw from being disengaged from said spline bush; wherein
   said spline portion formed on said screw base includes an annular groove,
   said spline bush includes a through-hole at the position corresponding to said annular groove of said screw base to be fitted thereinto,
   said retainer is inserted into said through-hole of said spline bush until its leading edge reaches said annular groove of said screw base, and
   said retainer is provided with a fastener means for fastening said retainer whose leading edge is engaged with said annular groove to the side of said screw sleeve.

2. A screw linkage structure in an injection molding machine according to claim 1, wherein
   said through-hole provided in said spline bush comprises a couple of through-holes each confronting the other with respect to the axis of said screw, and correspondingly said retainer also comprises a couple of retainers.

3. A screw linkage structure in an injection molding machine according to claim 1 or 2, wherein
   said retainer is fashioned into an elongated plate and has at its one edge a notch configured to correspond to said annular groove of said screw base.

4. A screw linkage structure in an injection molding machine according to claim 1, wherein
   said fastener means to be attached to said retainer comprises a plunger, a pin, and a spring for biasing said pin toward the direction in which said pin protrudes from said plunger, and wherein
   said screw sleeve includes at its front surface an engagement hole for receiving said pin at the position corresponding to that of said pin under the condition that the leading edge of said retainer has reached said annular groove of said screw base.

FIG.1

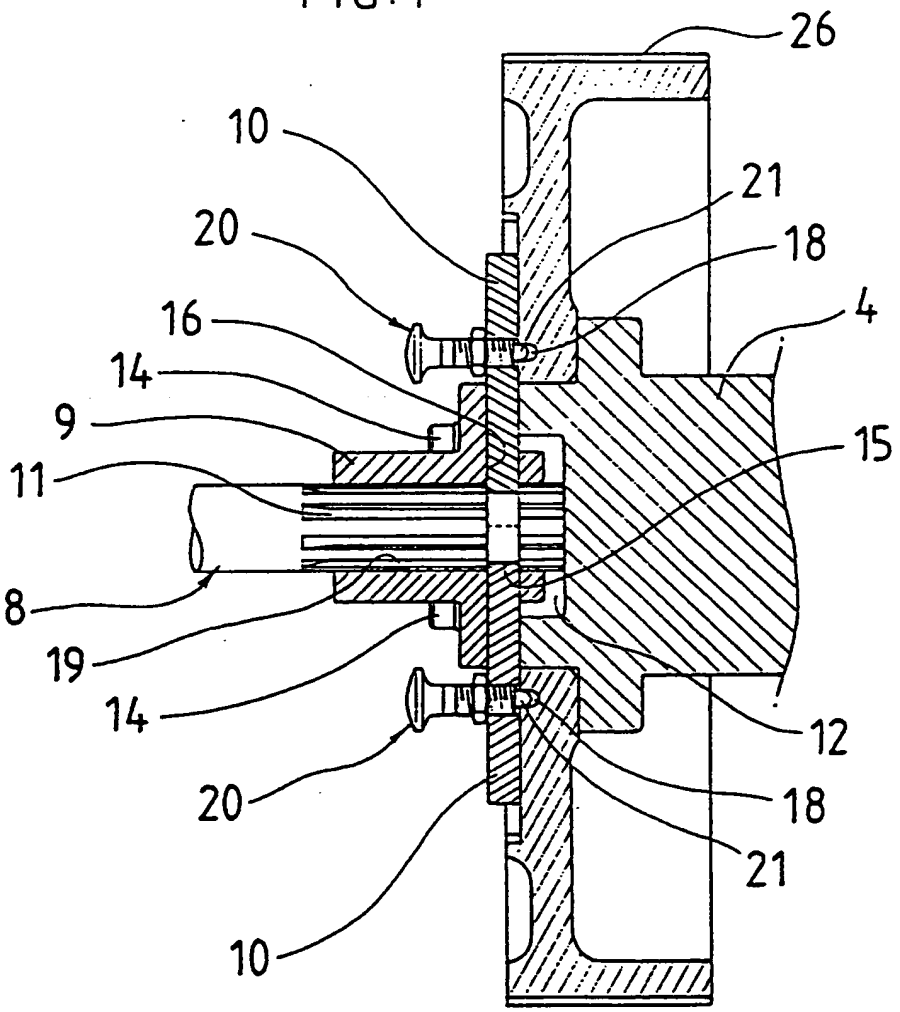
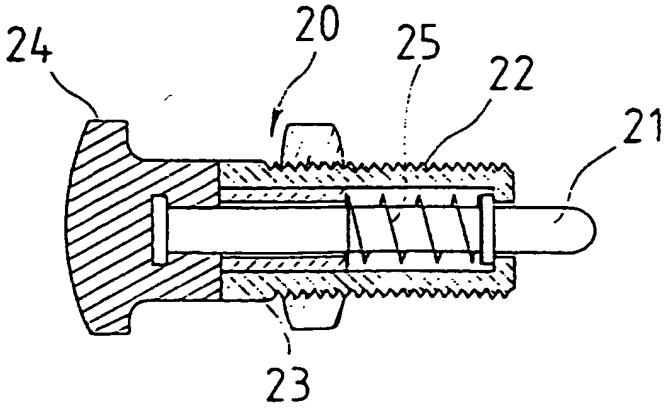


FIG.3



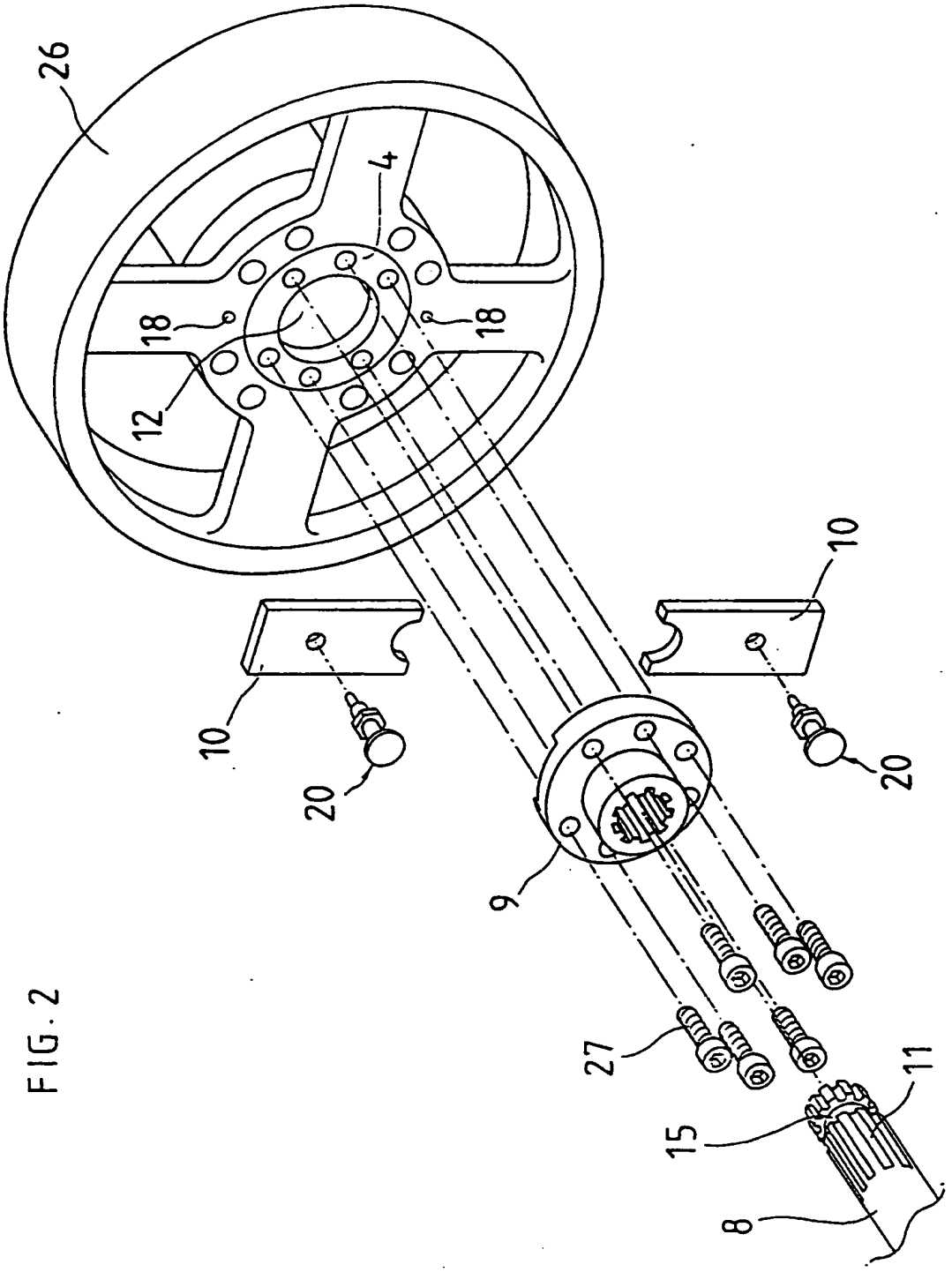


FIG. 2

FIG. 4

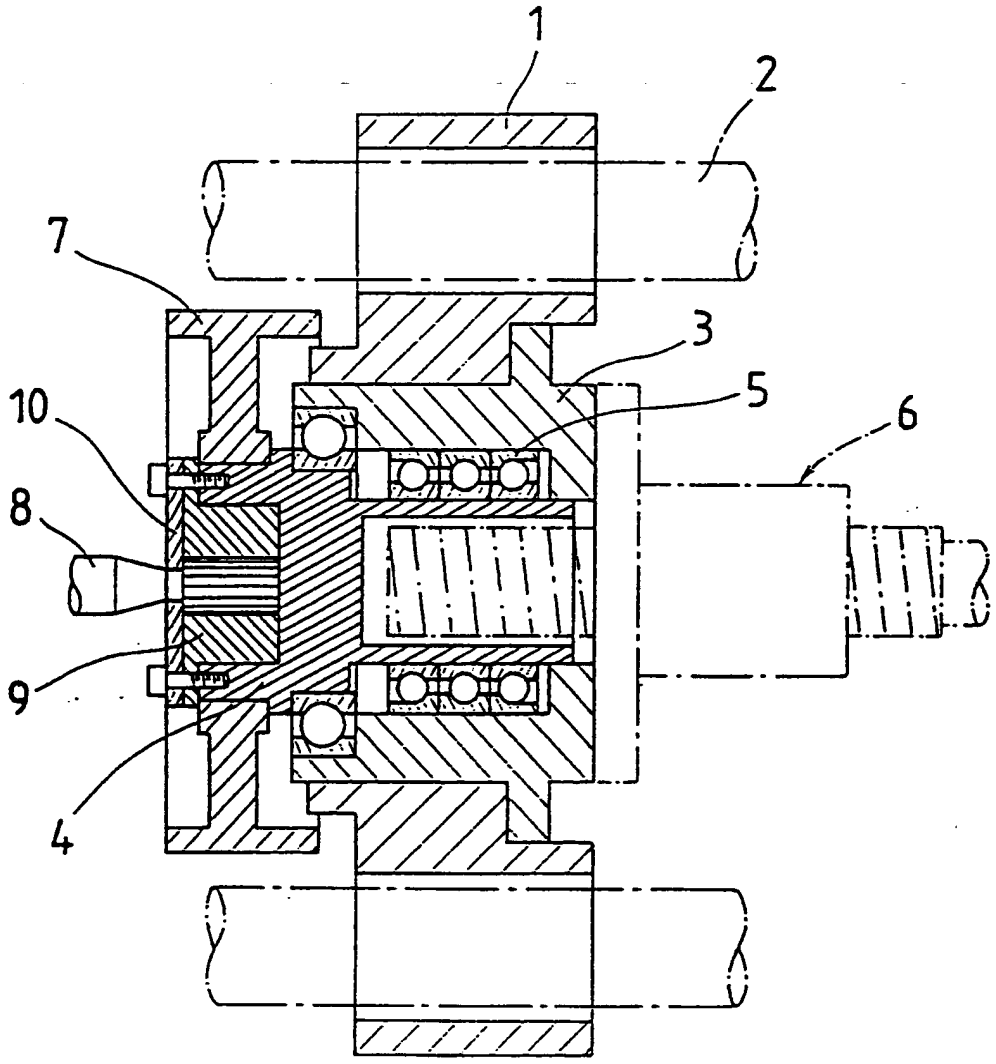


FIG.5

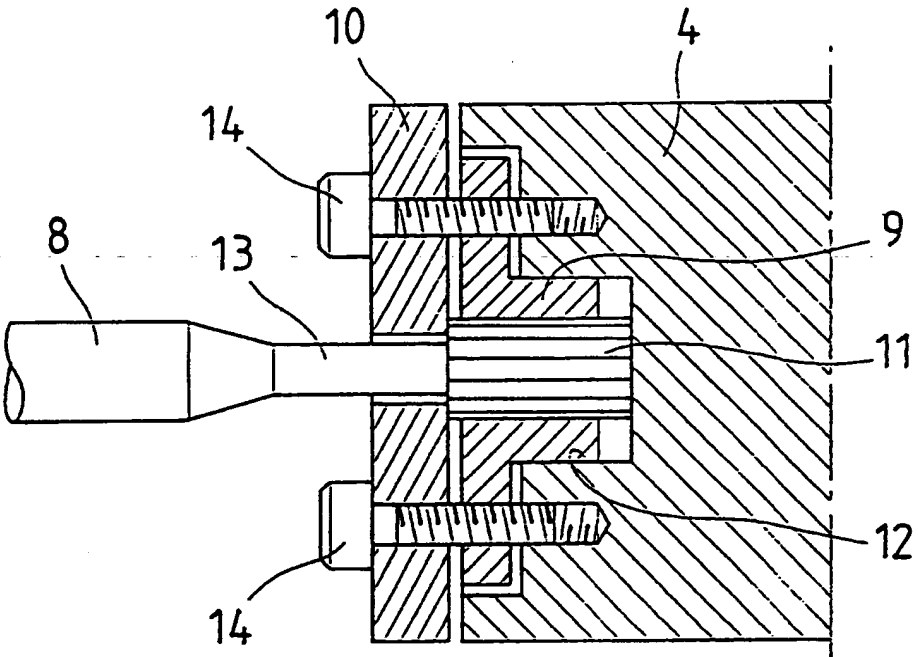
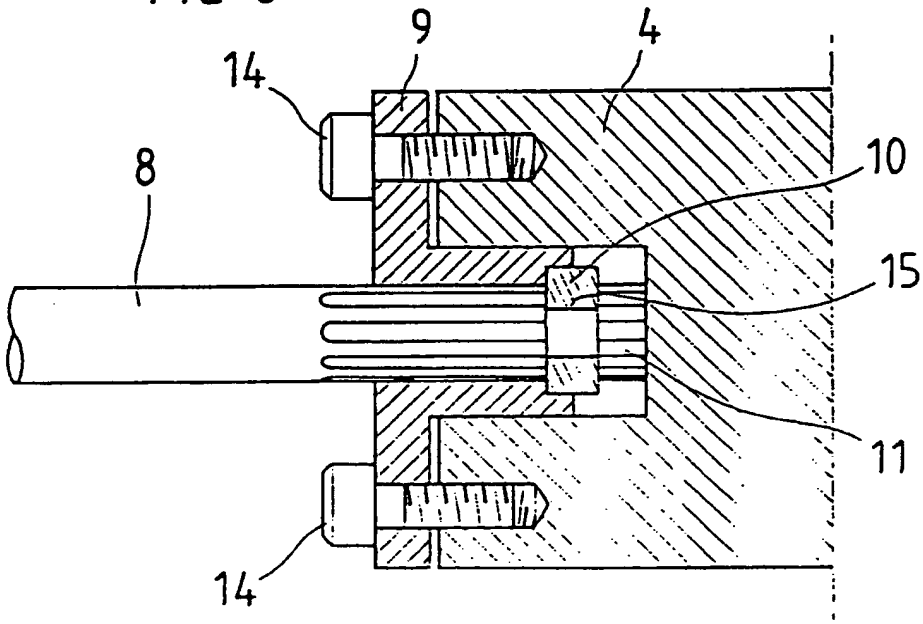


FIG.6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP92/01361

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^5 B29C45/60, 45/50

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl^5 B29C45/69, 45/50

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1962 - 1990
Kokai Jitsuyo Shinan Koho 1972 - 1992

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, Y2, 63-45292 (Nissei Jushi Kogyo K.K.), November 24, 1988 (24. 11. 88), Claim and drawings (Family: none)	1-4
A	JP, A, 3-213321 (Fanuc Ltd.), September 18, 1991 (18. 09. 91), Claim and drawings (Family: none)	1-4
A	JP, Y2, 63-34896 (Toshiba Machine Co., Ltd.), September 16, 1988 (16. 09. 88), Claim and drawings (Family: none)	1-4

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
December 9, 1992 (09. 12. 92)	January 19, 1993 (19. 01. 93)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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